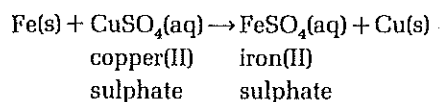


## 9.4 Competition between metals

A metal high in the reactivity series displaces a lower metal from a solution of one of its salts. For example:



Iron is more reactive than copper. It therefore displaces copper from copper(II) sulphate solution. This reaction can easily be observed by dipping a steel knife blade or paper clip into copper(II) sulphate solution. The blade or clip becomes coated with a brown layer of copper.

### Aim

To obtain an order of reactivity of metals by investigating displacement reactions.

### Apparatus and materials

5 test-tubes

Test-tube rack

Emery paper

Metals:

magnesium ribbon, 3 cm lengths

lead foil, 1 cm squares

copper foil, 1 cm squares

iron nails

zinc strip, 1 cm squares

Solutions, concentration 1 mol dm<sup>-3</sup>

magnesium sulphate

lead(II) nitrate

copper(II) sulphate

iron(II) sulphate

zinc sulphate

### Precaution

Lead(II) nitrate solution is poisonous. Wash your hands at the end of the experiment.

### Procedure

- 1 Clean each of the metals using emery paper.
- 2 Add 5 cm<sup>3</sup> of magnesium sulphate solution to each of five test-tubes.
- 3 Add a sample of each metal to the magnesium sulphate solutions.
- 4 Leave the test-tubes for three minutes. Gently scrape the surface of each metal to see if there is a deposit. If the result is uncertain repeat the experiment leaving the test-tube for 10 minutes.
- 5 Clean out the test-tubes and repeat steps 1–5 using each of the other solutions in turn.

### Results

Copy and complete the table at the bottom of the page.

Record a + if a reaction takes place.

Record a – if no reaction takes place.

Arrange the metals in order of reactivity

1 ..... (most reactive)

2 .....

3 .....

4 .....

5 ..... (least reactive)

### Questions

- 1 a) Why is lead(II) nitrate used rather than lead(II) sulphate?  
b) What is removed from the surface of these metals when they are cleaned?  
c) Why are sodium and calcium not used in the experiment?  
d) Which is the most reactive metal used?  
e) Predict the result of adding lead to silver nitrate solution.
- 2 Write equations for all the reactions taking place in the experiment.

	magnesium sulphate(aq)	lead(II) nitrate(aq)	copper(II) sulphate(aq)	iron(II) sulphate(aq)	zinc sulphate(aq)
magnesium					
lead					
copper					
iron					
zinc					